

CLAIMS:

1. A method of making a medical implant comprising:
 - a) providing a polymeric material;
 - b) consolidating the polymeric material;
 - c) irradiating the consolidated polymeric material with ionizing radiation, thereby forming a consolidated and cross-linked polymeric material;
 - d) machining the consolidated and cross-linked polymeric material, thereby forming a medical implant; and
 - e) doping the medical implant with an antioxidant by diffusion, thereby forming an antioxidant-doped cross-linked medical implant.
2. The method of claim 1, wherein the antioxidant-doped medical implant is packaged and sterilized by ionizing radiation or gas sterilization, thereby forming a sterile and cross-linked medical implant.
3. The method of claim 1, wherein the polymeric material is compression molded to another piece or a medical implant, thereby forming an interface or an interlocked hybrid material.
4. The method of claim 1, wherein the consolidated polymeric material is compression molded to another piece, thereby forming an interface and an interlocked hybrid material.
5. The method of claim 1, wherein the doping is carried out by soaking the medical implant in the antioxidant for about an hour or about 16 hours.
6. The method of claim 1, wherein the antioxidant is heated to about 100°C and the doping is carried out at 100°C.
7. The method of claim 1, wherein the antioxidant is heated to about room temperature and the doping is carried out at room temperature.
8. The method according to claim 1, wherein the cross-linked polymeric material is annealed at a temperature below the melt or above the melt of the consolidated and cross-linked polymeric material.

9. The polymeric material according to claim 1 is a polyolefin, a polypropylene, a polyamide, a poly ether ketone, or a mixture thereof.
10. The polyolefin of claim 9 is selected from a group consisting of a low-density polyethylene, high-density polyethylene, linear low-density polyethylene, ultra-high molecular weight polyethylene (UHMWPE), or a mixture thereof.
11. The method according to claim 1, wherein the implant comprises medical devices selected from the group consisting of acetabular liner, shoulder glenoid, patellar component, finger joint component, ankle joint component, elbow joint component, wrist joint component, toe joint component, bipolar hip replacements, tibial knee insert, tibial knee inserts with reinforcing metallic and polyethylene posts, intervertebral discs, sutures, tendons, heart valves, stents, vascular grafts.
12. The method according to claim 1, wherein the polymeric material is polymeric resin powder, polymeric flakes, polymeric particles, or the like, or a mixture thereof.
13. The method according to claim 1, wherein the irradiation is carried out in an atmosphere containing between about 1% and about 22% oxygen.
14. The method according to claim 1, wherein the irradiation is carried out in an inert atmosphere, wherein the inert atmosphere contains gas selected from the group consisting of nitrogen, argon, helium, neon, or the like, or a combination thereof.
15. The method according to claim 1, wherein the irradiation is carried out in a vacuum.
16. The method according to claim 1, wherein the cross-linked polymeric material is heated in an atmosphere containing between about 1% and about 22% oxygen.
17. The method according to claim 1, wherein the radiation dose is between about 25 and about 1000 kGy.
18. The method according to claim 1, wherein the radiation dose is about 65 kGy, about 75 kGy, or about 100 kGy.
19. The method according to claim 1, wherein the radiation is a gamma irradiation.
20. The method according to claim 1, wherein the radiation is an electron beam irradiation.

21. The method according to claim 1, wherein reduction of free radicals in the cross-linked polymeric material is achieved by heating the polymeric material in contact with a non-oxidizing medium.
22. The method according to claim 1, wherein reduction of free radicals in the cross-linked polymeric material is achieved by contacting with a non-oxidizing medium and heating the medium to above the melting temperature of the cross-linked polymeric material.
23. The method according to claim 22, wherein the non-oxidizing medium is an inert gas.
24. The method according to claim 22, wherein the non-oxidizing medium is an inert fluid.
25. The method according to claim 22, wherein the medium is a polyunsaturated hydrocarbon selected from the group consisting of: acetylenic hydrocarbons such as acetylene; conjugated or unconjugated olefinic hydrocarbons such as butadiene and (meth)acrylate monomers; and sulphur monochloride with chloro-tri-fluoroethylene (CTFE) or acetylene.
26. The method according to claim 1, wherein reduction of free radicals in the cross-linked polymeric material is achieved by heating the polymeric material to above the melting point of the cross-linked polymeric material.
27. The method of claim 1, wherein the medical implant is soaked in a solution, of about 50% by weight, of the antioxidant in ethanol.
28. The method of claim 1, wherein the medical implant is diffused with an antioxidant in a supercritical fluid.
29. The method of claim 28, wherein the supercritical fluid is CO₂.
30. The method according to claim 1, wherein the antioxidant is vitamin E.
31. The method according to claim 1, wherein the antioxidant is α -tocopherol.
32. The method of claim 1, wherein the medical implant is a non-permanent medical device.

33. The method of claim 32, wherein the non-permanent medical device is a catheter, a balloon catheter, a tubing, an intravenous tubing, or a suture.
34. A method of making a medical implant comprising:
- a) providing a polymeric material;
 - b) consolidating the polymeric material;
 - c) machining the consolidated polymeric material, thereby forming a medical implant;
 - d) irradiating the medical implant with ionizing radiation, thereby forming a cross-linked medical implant; and
 - e) doping the medical implant with an antioxidant by diffusion, thereby forming an antioxidant-doped cross-linked medical implant.
35. The method of claim 34, wherein the irradiated and antioxidant-doped medical implant is packaged and sterilized by ionizing radiation or gas sterilization, thereby forming a sterile and cross-linked medical implant.
36. The method of claim 34, wherein the polymeric material is compression molded to another piece or a medical implant, thereby forming an interface or an interlocked hybrid material.
37. The method of claim 34, wherein the consolidated polymeric material is compression molded to another piece, thereby forming an interface and an interlocked hybrid material.
38. The method of claim 34, wherein the doping is carried out by soaking the medical implant in vitamin E for about an hour or about 16 hours.
39. The method of claim 38, wherein the vitamin E is heated to about 100°C and the doping is carried out at 100°C.
40. The method of claim 38, wherein the vitamin E is heated to about room temperature and the doping is carried out at room temperature.
41. A method of making a medical implant comprising:
- a) providing a polymeric material;
 - b) consolidating the polymeric material;

- c) doping the consolidated polymeric material with an antioxidant by diffusion;
 - d) machining the antioxidant doped polymeric material, thereby forming an antioxidant doped polymeric material; and
 - e) irradiating the antioxidant doped cross-linked polymeric material by ionizing radiation, thereby forming an antioxidant doped cross-linked medical implant.
42. The method of claim 41, wherein the irradiated and antioxidant-doped medical implant is packaged and sterilized by ionizing radiation or gas sterilization, thereby forming a sterile and cross-linked medical implant.
43. The method of claim 41, wherein the polymeric material is compression molded to another piece or a medical implant, thereby forming an interface or an interlocked hybrid material.
44. The method of claim 41, wherein the consolidated polymeric material is compression molded to another piece, thereby forming an interface and an interlocked hybrid material.
45. The method of claim 41, wherein the doping is carried out by soaking the medical implant in vitamin E for about an hour or about 16 hours.
46. The method of claim 45, wherein the vitamin E is heated to about 100°C and the doping is carried out at 100°C.
47. The method of claim 45, wherein the vitamin E is heated to about room temperature and the doping is carried out at room temperature.
48. A method of making a medical implant comprising:
- a) providing a polymeric material;
 - b) consolidating the polymeric material;
 - c) doping the consolidated polymeric material with an antioxidant by diffusion;
 - d) irradiating the antioxidant doped polymeric material by ionizing radiation, thereby forming an antioxidant doped cross-linked polymeric material; and
 - e) machining the cross-linked polymeric material, thereby forming an antioxidant doped cross-linked medical implant.

49. The method of claim 48, wherein the irradiated and antioxidant-doped medical implant is packaged and sterilized by ionizing radiation or gas sterilization, thereby forming a sterile and cross-linked medical implant.

50. The method of claim 48, wherein the polymeric material is compression molded to another piece or a medical implant, thereby forming an interface or an interlocked hybrid material.

51. The method of claim 48, wherein the consolidated polymeric material is compression molded to another piece, thereby forming an interface and an interlocked hybrid material.

52. The method of claim 48, wherein the doping is carried out by soaking the medical implant in vitamin E for about an hour or about 16 hours.

53. The method of claim 52, wherein the vitamin E is heated to about 100°C and the doping is carried out at 100°C.

54. The method of claim 52, wherein the vitamin E is heated to about room temperature and the doping is carried out at room temperature.

55. A method of making a medical implant comprising:

- a) providing a polymeric material;
- b) consolidating the polymeric material;
- c) machining the consolidated polymeric material, thereby forming a medical implant;
- d) doping the medical implant with an antioxidant by diffusion, thereby forming an antioxidant doped medical implant;
- e) packaging the medical implant; and
- f) irradiating the packaged medical implant by ionizing radiation, thereby forming an antioxidant doped cross-linked and sterile medical implant.

56. The method of claim 55, wherein the polymeric material is compression molded to another piece or a medical implant, thereby forming an interface or an interlocked hybrid material.

57. The method of claim 55, wherein the radiation dose is between about 25 kGy and about 150 kGy.

58. The method of claim 55, wherein the consolidated polymeric material is compression molded to another piece, thereby forming an interface and an interlocked hybrid material.

59. The method of claim 55, wherein the doping is carried out by soaking the medical implant in vitamin E for about an hour or about 16 hours.

60. The method of claim 59, wherein the vitamin E is heated to about 100°C and the doping is carried out at 100°C.

61. The method of claim 59, wherein the vitamin E is heated to about room temperature and the doping is carried out at room temperature.

62. A method of making a medical implant comprising:

- a) providing a polymeric material;
- b) compression molding the polymeric material, thereby forming a medical implant;
- c) doping the medical implant with an antioxidant by diffusion, thereby forming an antioxidant doped medical implant;
- d) packaging the medical implant; and
- e) irradiating the packaged medical implant by ionizing radiation, thereby forming an antioxidant doped cross-linked and sterile medical implant.

63. The method of claim 62, wherein the polymeric material is compression molded to another piece or a medical implant, thereby forming an interface or an interlocked hybrid material.

64. The method of claim 62, wherein the radiation dose is between about 25 kGy and about 150 kGy.

65. The method of claim 62, wherein the doping is carried out by soaking the medical implant in vitamin E for about an hour or about 16 hours.

66. The method of claim 65, wherein the vitamin E is heated to about 100°C and the doping is carried out at 100°C.

67. The method of claim 65, wherein the vitamin E is heated to about room temperature and the doping is carried out at room temperature.

68. The method according to claim 62, wherein the interlocked hybrid material is annealed at a temperature below the melt or above the melt of the cross-linked polymeric material.
69. The polymeric material according to claim 62 is a polyolefin, a polypropylene, a polyamide, a poly ether ketone, or a mixture thereof.
70. The polyolefin of claim 62 is selected from a group consisting of a low-density polyethylene, high-density polyethylene, linear low-density polyethylene, ultra-high molecular weight polyethylene (UHMWPE), or a mixture thereof.
71. The method according to claim 62, wherein the implant comprises medical devices selected from the group consisting of acetabular liner, shoulder glenoid, patellar component, finger joint component, ankle joint component, elbow joint component, wrist joint component, toe joint component, bipolar hip replacements, tibial knee insert, tibial knee inserts with reinforcing metallic and polyethylene posts, intervertebral discs, sutures, tendons, heart valves, stents, vascular grafts.
72. The method according to claim 62, wherein the polymeric material is polymeric resin powder, polymeric flakes, polymeric particles, or the like, or a mixture thereof.
73. The method according to claim 62, wherein the piece is metallic or non metallic.
74. The method according to claim 62, wherein the piece is a metal, a ceramic, or a polymer.
75. The method according to claim 62, wherein the interface is a metal-polymer.
76. The method according to claim 62, wherein the interface is a metal-ceramic.
77. A method of making a medical implant comprising:
- a) providing a consolidated polymeric material;
 - b) irradiating the consolidated polymeric material with ionizing radiation, thereby forming a consolidated and cross-linked polymeric material;
 - c) machining the consolidated and cross-linked polymeric material, thereby forming a medical implant; and
 - d) doping the medical implant with an antioxidant by diffusion, thereby forming an antioxidant-doped cross-linked medical implant.

78. A polymeric material containing detectable residual free radicals, wherein the polymeric material is non-oxidizing and cross-linked.

79. A medical implant comprising non-oxidizing cross-linked polymeric material containing detectable residual free radicals.